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Use of Tissue Testing to Prevent Low Grain Protein Content in Durum

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Summary

Low grain protein content in durum can be prevented by applying nitrogen fertilizer after heading. Tentative guidelines were established from previous research for nitrogen fertilizer applications after heading based on the lower stem nitrate content near heading. Three durum fields in Pinal County were selected for testing the use of these guidelines for ensuring grain protein contents greater than 13%. These fields were split into plots that either received late N fertilization after heading or not. The stem nitrate content at heading for two of the fields averaged 6337 ppm, indicating no need for late N fertilizer application to achieve grain protein content above 13%, and the grain protein content for these fields averaged 15.1% with or without late N fertilizer. The stem nitrate content at heading was 894 ppm for the third field, the stem nitrate guidelines called for a late N application of about 63 lbs N/a, and a late N application of 46 lbs N/a increased grain yield protein from 11.54 to 13.34%. Our tentative nitrogen fertilizer recommendations based on stem samples near heading appear accurate.

Introduction

Low protein content in durum is caused primarily by nitrogen deficiency later in the season. We have conducted research on using various tissue tests at heading to predict the need for late season nitrogen application to increase grain protein (Riley et al., 1998; Riley et al., 1999). The most promising of these tests is the lower stem nitrate test. We have developed tentative guidelines for the use of this test, and propose to test the use of these tentative guidelines on commercial farms (Doerge et al., 1991). The purpose of this investigation is to evaluate the tentative guidelines for the use of the lower stem nitrate test at heading to prevent low grain protein content in durum.

Procedures

Three fields were selected in Pinal County for evaluation of the use of the lower stem nitrate test at heading to prevent low grain protein content in durum. The lower portion of the stem was sampled at heading and nitrate content determined. The field was split into plots that would or would not receive nitrogen fertilizer after heading. Grain protein content was measured at harvest. The target grain protein is 13%. The characteristics of each site are presented in Table 2.

Results and Discussion

Stem nitrate content at heading at the two fields in Casa Grande were about 6000 to 7000 ppm (Table 2), which is considered to be very high and indicate that grain protein content at harvest would be above 13% without additional N fertilization. This was indeed the case since grain protein content was about 15% without late N fertilization. A late N fertilization of 67 lbs N/a did not result in a further increase in grain protein. The stem nitrate content at heading at the Maricopa site was slightly less than 1000 ppm, and according to the stem nitrate guidelines, would require about 63 lbs N/acre to achieve greater than 13% grain protein. A late N application of 46 lbs N/acre increased grain protein from 11.54 to 13.34%. Stem nitrate at heading appears to be a good indicator of grain protein content.

References

Doerge, T. A., R. L. Roth, and B. R. Gardner. 1991. Nitrogen fertilizer management in Arizona. Univ. Ariz. College Agric. Tucson.

Riley, E. A., T. L. Thompson, S. A. White, and M. J. Ottman. 1998. Late season tissue tests for critical grain protein content in Durum, Maricopa, 1998. p. 43-50. Forage and Grain. Univ. Ariz. College Agric. Report Series P-114. Tucson.

Riley, E. A., T. L. Thompson, S. A. White, and M. J. Ottman. 1999. Late season tissue tests for critical grain protein content in Durum, Maricopa, 1999. p. 76-83. Forage and Grain. Univ. Ariz. College Agric. Report Series P-118. Tucson.

Table 1. Recommended growth stages for lower stem tissue sampling and interpretation of lower stem nitrate-N levels for small grains in Arizona (Doerge et al., 1991). Proposed interpretation of lower stem nitrate-N levels at the heading stage is in bold.

Stage at Stem Sampling	Stem Nitrate-N Levels	Stage at N Fertilizer Application	Suggested N Fertilizer Rates
	ppm		lbs N/acre
3-4 leaf	>5000	3-4 leaf to Joint	0
	2000-5000		0 - 50
	<2000		50 - 100
Joint	>3000	Joint to Boot	0
	1000-3000		0 - 50
	1000		50 - 75
Boot	>3000	Boot to Heading	0
	1000-3000		0 – 30
	1000		30 - 60
Heading	**>3000**	**Heading to Milk**	**0 - 30**
	1000-3000		**30 - 60**
	1000		**60 - 90**

Table 2. Cultural practices and other pertinent information related to stem nitrate concentration near heading and grain protein for various sites.

Location	Casa Grande	Casa Grande	Maricopa
Grower	Grasty	Grasty	Ag. Center
Field	North	South	Field 3, Border 61
Variety	Kronos	Kronos	Duraking
Plot size	5 acres (3 borders)	5 acres (3 borders)	60 ft x 20 ft
Replications	3	3	4
Planting date	12/20/04	12/20/04	12/1/04
Irrigations	3/1, 3/28, 4/11, 4/25	3/1, 3/28, 4/11, 4/25	12/1, 1/28, 3/4, 3/18, 4/1, 4/15, 4/30
Fertilization	225 lb/a 11-52-0 (12/20)	225 lb/a 11-52-0 (12/20)	500 lb/a 16-20-0 (12/1)
	100 lbs/a 46-0-0 (12/20)	100 lbs/a 46-0-0 (12/20)	100 lbs/a 46-0-0 (1/28)
	28 gal/a 32-0-0 (3/1)	28 gal/a 32-0-0 (3/1)	100 lbs/a 46-0-0 (3/4)
	19 gal/a 32-0-0 (3/28) Late N plots only	19 gal/a 32-0-0 (3/28) Late N plots only	100 lbs/a 46-0-0 (4/1) Late N plots only
N rate (lbs N/a) Control	170	170	172
N rate (lbs N/a) Late N	237	237	218
P rate (lbs P_2O_5/a)	117	117	100
Yield (lbs/a)	5400	5400	6346
Grain protein (%) Control	15.36	14.84	11.54
Grain protein (%) Late N	15.45	14.78	13.34
Stem sample date	3/22	3/22	3/25
Stem nitrate (ppm) near heading	6800	5875	894
N applied after stem sample to late N plots (lbs N/a)	67	67	46
N recommended after stem sample (lbs N/a) according to Table 1	0	0	63